

IPC-2516A

Sectional Requirements for Implementation of Assembled Board Product Manufacturing Data Description [BDASM]

“The data model of this standard shall be in effect until 2001-12.” At that time, the committee will consider changes, revision, other actions.

IPC-2516A
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A standard developed by IPC

2215 Sanders Road, Northbrook, IL 60062-6135
Tel. 847.509.9700 Fax 847.509.9798
www.ipc.org

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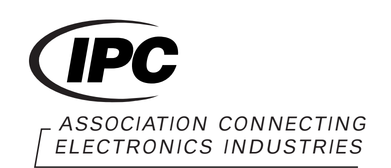
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IPC-2516A



[BDASM]

Sectional Requirements for Implementation of Assembled Board Product Manufacturing Data Description

A standard developed by the Computerized Data Format Standardization Subcommittee (2-11) of the Data Generation and Transfer Committee (2-10) of the Institute for Interconnecting and Packaging Electronic Circuits.

The GenCAM format is intended to provide CAD-to-CAM, or CAM-to-CAM data transfer rules and parameters related to manufacturing printed boards and printed board assemblies. The requirements of IPC-2511 are a mandatory part of this sectional standard.

This standard is part of the GenCAM 1.5 release.

> **“The data model of this standard shall be in effect until 2001-12.”** At that time, the committee will consider changes, revision, other actions.

Users of this standard are encouraged to participate in the development of future revisions.

Contact:

IPC
2215 Sanders Road
Northbrook, Illinois
60062-6135
Tel 847 509.9700
Fax 847 509.9798

Acknowledgment

Any Standard involving a complex technology draws material from a vast number of sources. While the principal members of the IPC Data Generation and Transfer Committee of the IPC Data Transfer Solution DTS Subcommittee are shown below, it is not possible to include all of those who assisted in the evolution of this standard. To each of them, the members of the IPC extend their gratitude.

Data Generation and Transfer Committee

Chairman
Harry Parkinson
Digital Equipment

Data Transfer Solution DTS Subcommittee

Chairman
Harry Parkinson
Digital Equipment

Technical Liaisons of the IPC Board of Directors

Stan Plzak
Pensar Corp.

Peter Bigelow
Beaver Brook Circuits Inc.

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1 SCOPE

This standard specifies data formats used to describe printed circuit board assembly product manufacturing methodologies. These formats may be used for transmitting information between a printed circuit board designers, board fabricators, and assembly manufacturers. The formats are also useful when the manufacturing cycle includes computer-aided processes and numerical control machines.

The information can be used for both manual and for digital interpretations. The data may be defined in either English or SI units.

1.1 Interpretation

"**Shall**", the emphatic form of the verb, is used throughout this standard whenever a requirement is intended to express a provision that is mandatory. Deviation from a **shall** requirement is not permitted, and compliance test modules (CTMs) developed to check syntax and semantics, will prompt the user to correct the ambiguity, or to insert missing information.

The words "should" and "may" are used whenever it is necessary to express non-mandatory provisions.

"Will" is used to express a declaration of purpose.

To assist the reader, the word **shall** is presented in bold characters.

1.2 Assembled Board Product Manufacturing Focus

The GenCAM format requirements are provided in a series of standards focused on printed circuit board manufacturing, assembly, inspection, and testing. This standard (IPC-2516) provides information on assembled board manufacturing requirements. The generic standard (IPC-2511) contains general requirements and is a mandatory part of the requirements of this standard, and provides general information necessary to completely understand the GenCAM structure.

2 APPLICABLE DOCUMENTS

The following documents contain provisions which, through reference in this text, constitutes provisions of IPC-2516. At the time of publication, the editions indicated were valid. All documents are subject to revision and parties to agreements based on this generic standard are encouraged to investigate the possibility of applying the most recent additions of the documents indicated below.

IPC-T-50		Terms and Definitions for Interconnecting and Packaging Electronic Circuits
IPC-2511	(MANGN)	Generic Requirements for Implementation of Product Manufacturing Description Data and Transfer
IPC-2512	(ADMIN)	Sectional Requirements for Implementation of Administrative Methods for

		Manufacturing Data Description
IPC-2513	(DRAWG)	Sectional Requirements for Implementation of Drawing Methods for Manufacturing Data Description
IPC-2514	(BDFAB)	Sectional Requirements for Implementation of Printed Board Fabrication Data Description
IPC-2515	(BDTST)	Sectional Requirements for Implementation of Bare Board Product Electrical Testing Data Description
IPC-2517	(ASEMT)	Sectional Requirements for Implementation of Assembly In-Circuit Testing Data Description
IPC-2518	(PTLST)	Sectional Requirements for Implementation of Part List Product Data Description
IPC-2519	(MODEL)	Sectional Requirements for Information Model Data Related to the Printed Board and Printed Board Manufacturing Descriptions

3 REQUIREMENTS

The requirements of IPC-2511 are a mandatory part of the standard. That document describes the generic requirements of the GenCAM format. The format specifies details specifically for information interchange of data related to printed board manufacturing, assembly, and test.

GenCAM is comprised of twenty sections as described in the generic GenCAM standard, IPC-2511. The sections are shown in Tables 3-1 and 3-2 of the IPC-2511.

Each section has a specific function or task respectively and is independent of each other. Accordingly, the information interchange for a specific purpose is possible only if the sections required for such a purpose have been prepared.

3.1 Categories and Content

Table 3-1 provides the section names that are appropriate for the printed board assembly processes. There are five unique functions that can be defined by the use of these files of the GenCAM system.

Table 3-1 indicates the relationships of the requirements for various sections within the descriptions for a particular process. The letter **"M"** signifies a *mandatory* requirement. The letter **"O"** signifies an *optional* characteristic that may or may not be pertinent to the particular file. A dash signifies an extraneous section (unnecessary); CTMs will not reject file summaries if extraneous sections are present.

The table signifies two requirement conditions separated by a "/". The first representation of requirements is intended to convey those GenCAM sections that **shall** be available as the initial input to the Assembly processes. The second instance of a requirement is to signify those data that **shall** be available once the processing descriptions have been completed.

Table 3-1 GenCAM Section Relationships for Assembly Data

Section Identifiers	Board Assembly	Panel Assembly	Assembly Preparation	Mechanical Hardware	Assembly Fixtures	Glue Dot	Solder Stencil
HEADERS	M/M	M/M	M/M	M/M	M/M	M/M	M/M
ADMINISTRATION	M/M	M/M	M/M	M/M	M/M	M/M	M/M
PRIMITIVES	M/M	M/M	M/M	M/M	M/M	M/M	M/M
ARTWORKS	M/M	M/M	M/M	M/M	M/M	M/M	M/M
LAYERS	M/M	M/M	-/-	M/M	M/M	M/M	M/M
PADSTACKS	M/M	M/M	-/-	-/-	-/-	-/-	M/M
PATTERNS	M/M	M/M	-/-	-/-	-/-	-/-	M/M
PACKAGES	M/M	M/M	M/M	-/-	O/O	M/M	M/M
FAMILIES	-/-	-/-	-/-	-/-	-/-	-/-	-/-
DEVICES	M/M	M/M	M/M	-/-	-/-	M/M	M/M
MECHANICALS	M/M	M/M	O/M	M/M	-/-	-/-	-/-
COMPONENTS	M/M	M/M	M/M	M/M	O/O	M/M	M/M
ROUTES	-/-	-/-	-/-	-/-	-/-	-/-	-/-
POWER	-/-	-/-	-/-	-/-	-/-	-/-	-/-
TESTCONNECTS	-/-	-/-	-/-	-/-	-/-	-/-	-/-
BOARDS	M/M	M/M	M/M	-/-	M/M	M/M	M/M
PANELS	-/-	O/M	O/M	-/-	O/M	O/M	O/M
FIXTURES	-/O	-/O	-/O	-/-	M/M	-/O	-/M
DRAWINGS	O/O	O/O	M/M	M/M	O/O	-/-	-/O
CHANGES	-/O*	-/O*	-/O*	-/O*	-/O*	-/O*	-/O*

* The CHANGES section is used independently to alter previously sent files. Included **shall** be a HEADER section (for revision status and identification) and an ADMINISTRATION section to show effectivity

The correlation between the various descriptions identified in this standard is indicated in Figure 3-1. This shows the relationship of the various assembly process steps.

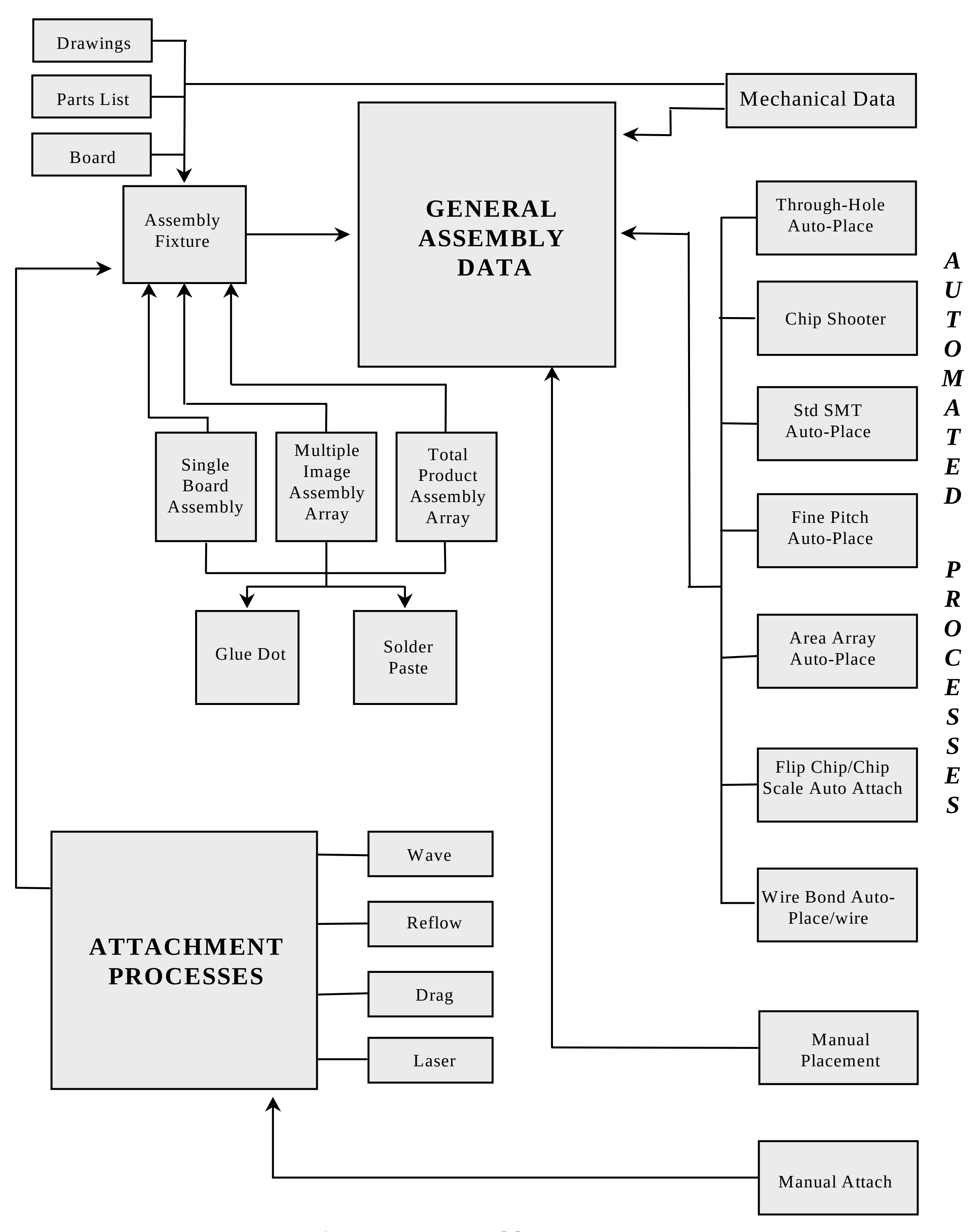


Figure 3-1 Assembly Process Steps

4 GENERAL RULES

The following details reflect the rules used in GenCAM to meet the requirements for assembly data. These rules are intended to meet the needs of the manufacturer to understand the customer requirements.

Wherever necessary, additional requirements have been detailed to reflect precision. The attributes and rules for GenCAM described in IPC-2511 are required.

Wherever necessary, detailed descriptions or definitions of the entities, attributes or characteristics are described according to the following issues detailed in Table 4.1 and descriptions.

Table 4-1 Keyword Usage

Need Identifier	Section Keyword	Keyword Usage
Component X-Y placement Component rotation Component top or bottom side	COMPONENTS	COMPONENT.<place> COMPONENT.<place> COMPONENT.<layersingle_ref>
Part reference designator	COMPONENTS	COMPONENT.<ref_desig>
Describes physical device	COMPONENTS DEVICES PACKAGES	COMPONENT.<device_ref> DEVICE.<package_ref> PACKAGE.BODY.<artwork_ref>
Pin identification	COMPONENTS DEVICES PACKAGES	COMPONENT.<device_ref> DEVICE.<package_ref> PACKAGE.BODY.PIN.<pattern_pin_ref>
Centroid of a part for SMT Placement	COMPONENTS DEVICES PACKAGES	COMPONENT.<device_ref> DEVICE.<package_ref> PACKAGE.<package_centroid>
Assembly drawings set	DRAWINGS	DRAWING.<drawing_type>
Parts	COMPONENTS DEVICES	COMPONENT.<device_ref> DEVICE.<part_name>
Pin 1 location	COMPONENTS DEVICES PACKAGES	COMPONENT.<device_ref> DEVICE.<package_ref> PACKAGE.BODY.PINONE.<pattern_pin_ref>
Size and Shape	COMPONENTS DEVICES PACKAGES	COMPONENT.<device_ref> DEVICE.<part_name> PACKAGE.<package_height> PACKAGE.<package_standoff>
Pin Pattern	COMPONENTS DEVICES PATTERNS	COMPONENT.<device_ref> DEVICE.PINDESC.<pattern_pin_ref> PATTERNDEF.PADSTACKREF.<pattern_pin_name> PATTERNDEF.PADSTACKREF.<place>
Performance	DRAWINGS	DRAWING.<drawing_type>
Solder paste definition	COMPONENTS DEVICES PATTERNS PADSTACKS LAYERS	COMPONENT.<device_ref> DEVICE.PINDESC.<pattern_pin_ref> PATTERNDEF.PADSTACKREF.<pattern_pin_name> PATTERNDEF.PADSTACKREF.<place> PADSTACK.PAD.<layers_ref> PADSTACK.PAD.<pad_primitive_ref> LAYER.<GenCAM_layer_type>
Glue pattern in graphic primitives	COMPONENTS DEVICES PACKAGES	COMPONENT.<device_ref> DEVICE.<package_ref> PACKAGE.BODY.<artwork_ref>
Fiducials	PATTERNS ARTWORKS	TARGETREF.<target_ref> TARGETREF.<place> TARGETDEF.<target_name>

Need Identifier	Section Keyword	Keyword Usage
Bad board mark	PATTERNS ARTWORKS	PATTERNDEF.FEATUREREF FEATUREDEF.<feature_name>
Tooling hole location and size	BOARDS PANELS PADSTACKS	BOARD.HOLEREF.<hole_ref> BOARD.HOLEREF.<position> PANEL.HOLEREF.<hole_ref> PANEL.HOLEREF.<position> HOLEDEF.<hole_name> HOLEDEF.<hole_type>
Person to accept the assembly	ADMINISTRATON	ACCEPT.<person_id>

5 MODELING

The data sections of GenCAM may be mapped to the information models. Information models are developed to ensure that complete mapping is capable between the information provided within the GenCAM characteristics. The correlation is provided in the activity models shown in IPC-2519.

All data activities are based on activity models as defined in IPC-2519. The activity models covered by CAD and CAM include the engineering, design, administrative, and fabrication and assembly characteristics. Each of these sections are intended to be detailed into various levels of activity much like layers of information needed to perform a particular manufacturing process.

Figure 5-1 shows the activity needed to develop administrative data.

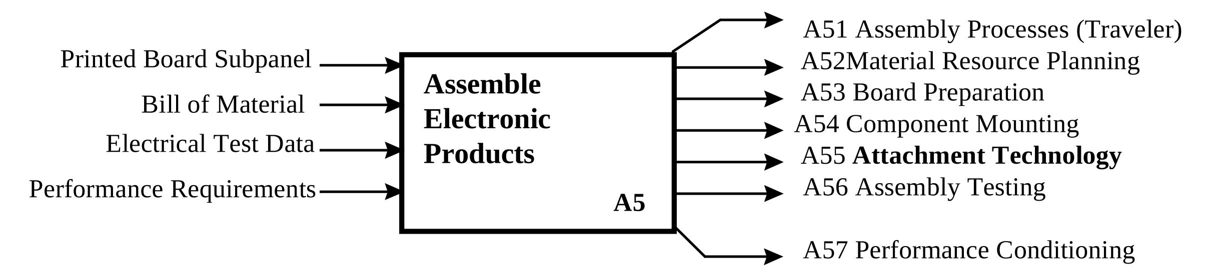


Figure 5-1 Assembly Information Activity

5.1 Information Models

Information models are also helpful in understanding the requirements of the assembled board product manufacturing section. Attribute information is correlated to the parameters of GenCAM as well as to the activity models used to describe assembled board product manufacturing data.

EXPRESS is an international information modeling format supported by ISO 10303-11. The graphic representation of EXPRESS is known as EXPRESS-G. Appendix A provides an explanation of the different EXPRESS-G requirements. Figures 5-2 through 5-6 show the EXPRESS-G version of the GenCAM PACKAGES, DEVICES, COMPONENTS, PATTERNS, and MECHANICALS sections. See www.gencam.org for complete EXPRESS-G model.

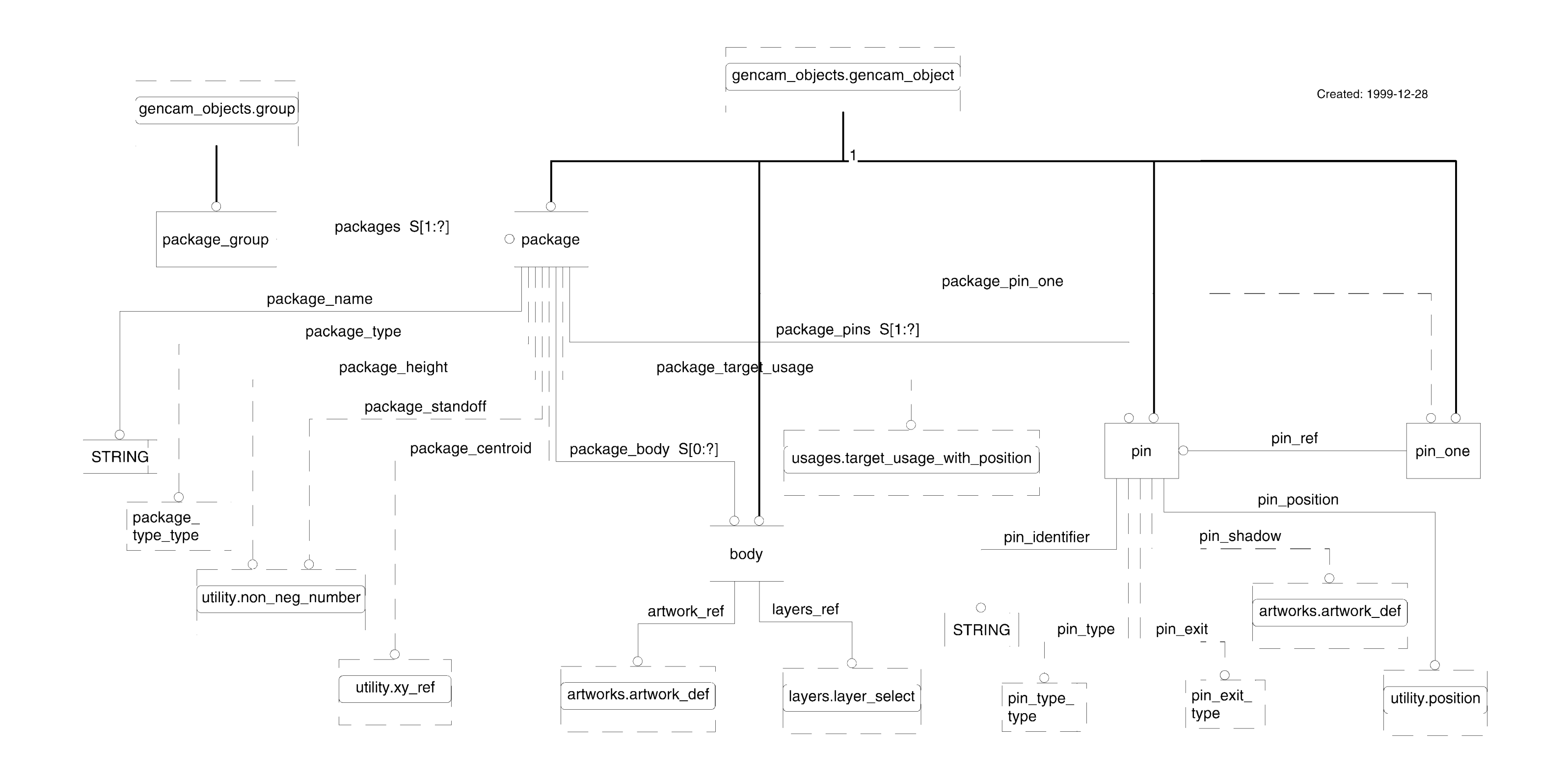


Figure 5-2 EXPRESS-G for PACKAGES

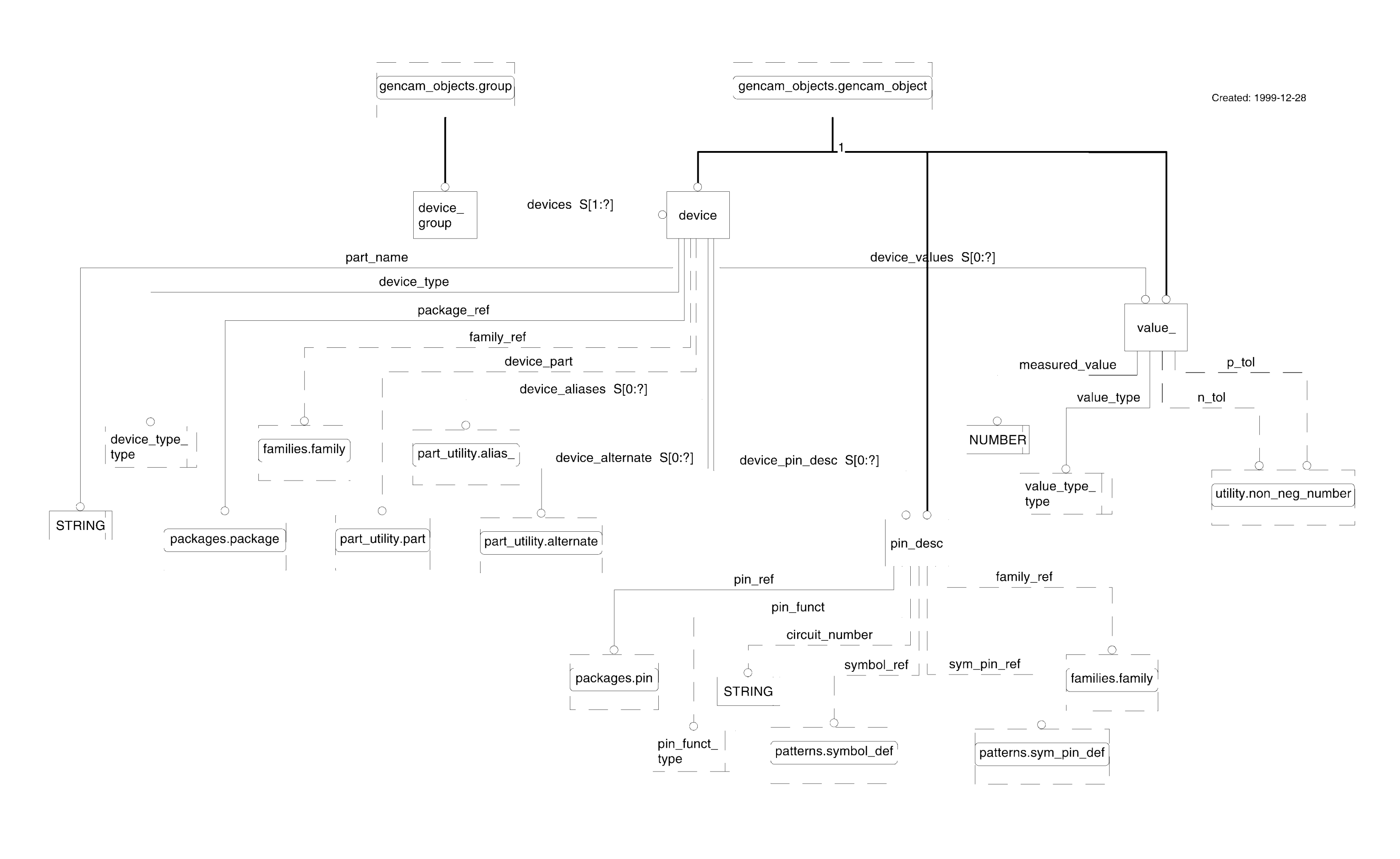


Figure 5-3 EXPRESS-G for DEVICES

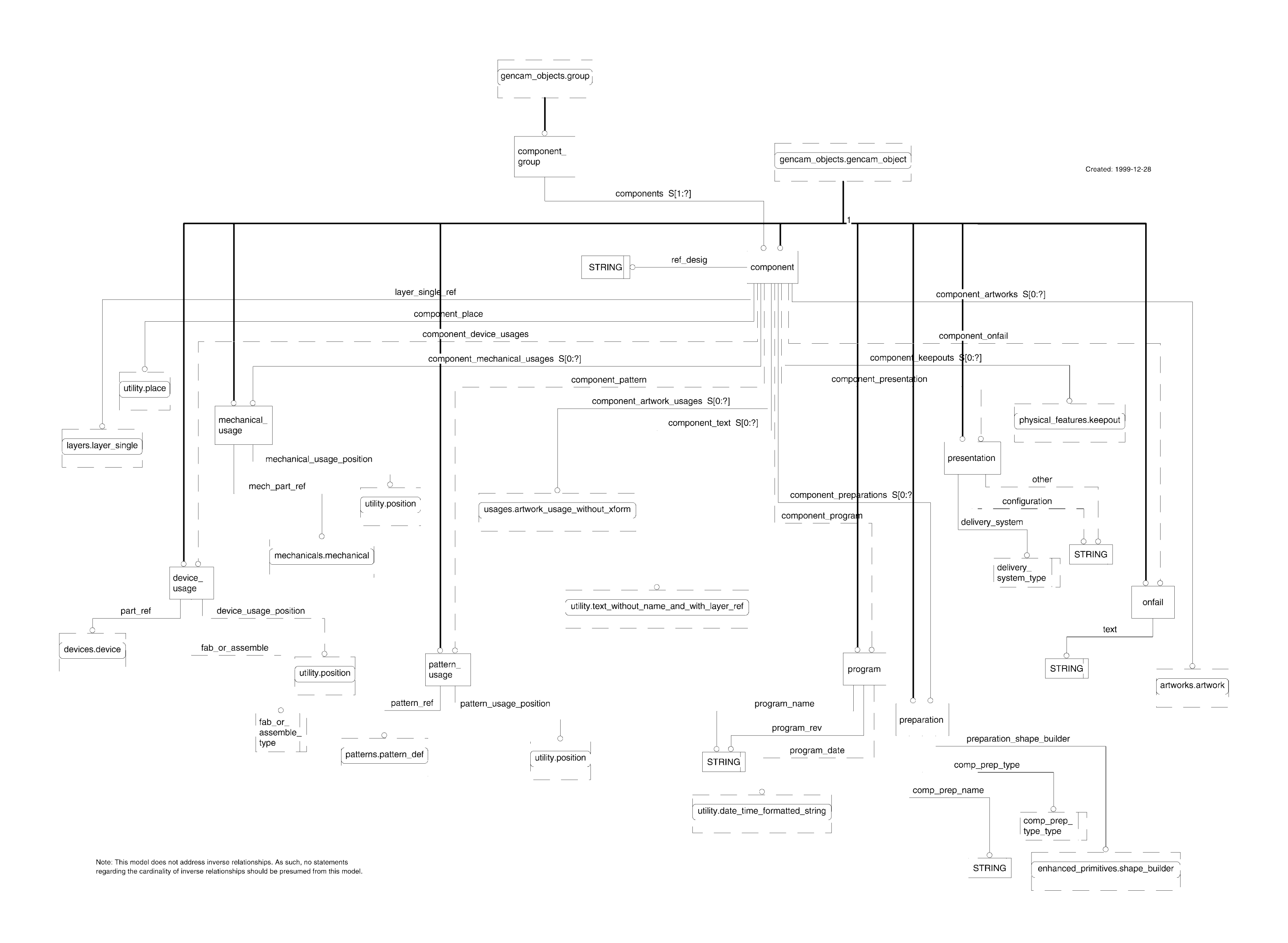


Figure 5-4 EXPRESS-G for COMPONENTS

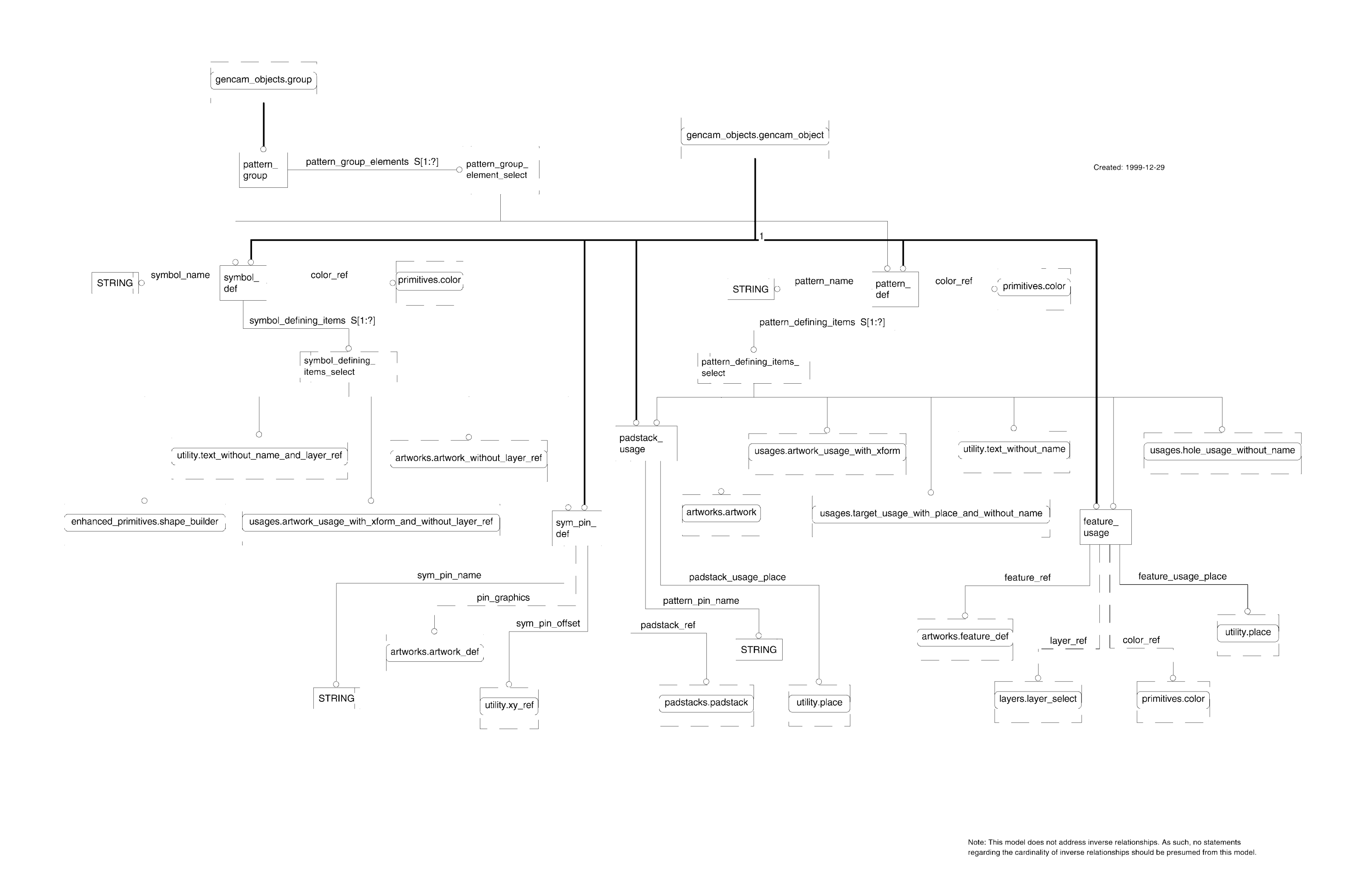


Figure 5-5 EXPRESS-G for PATTERNS

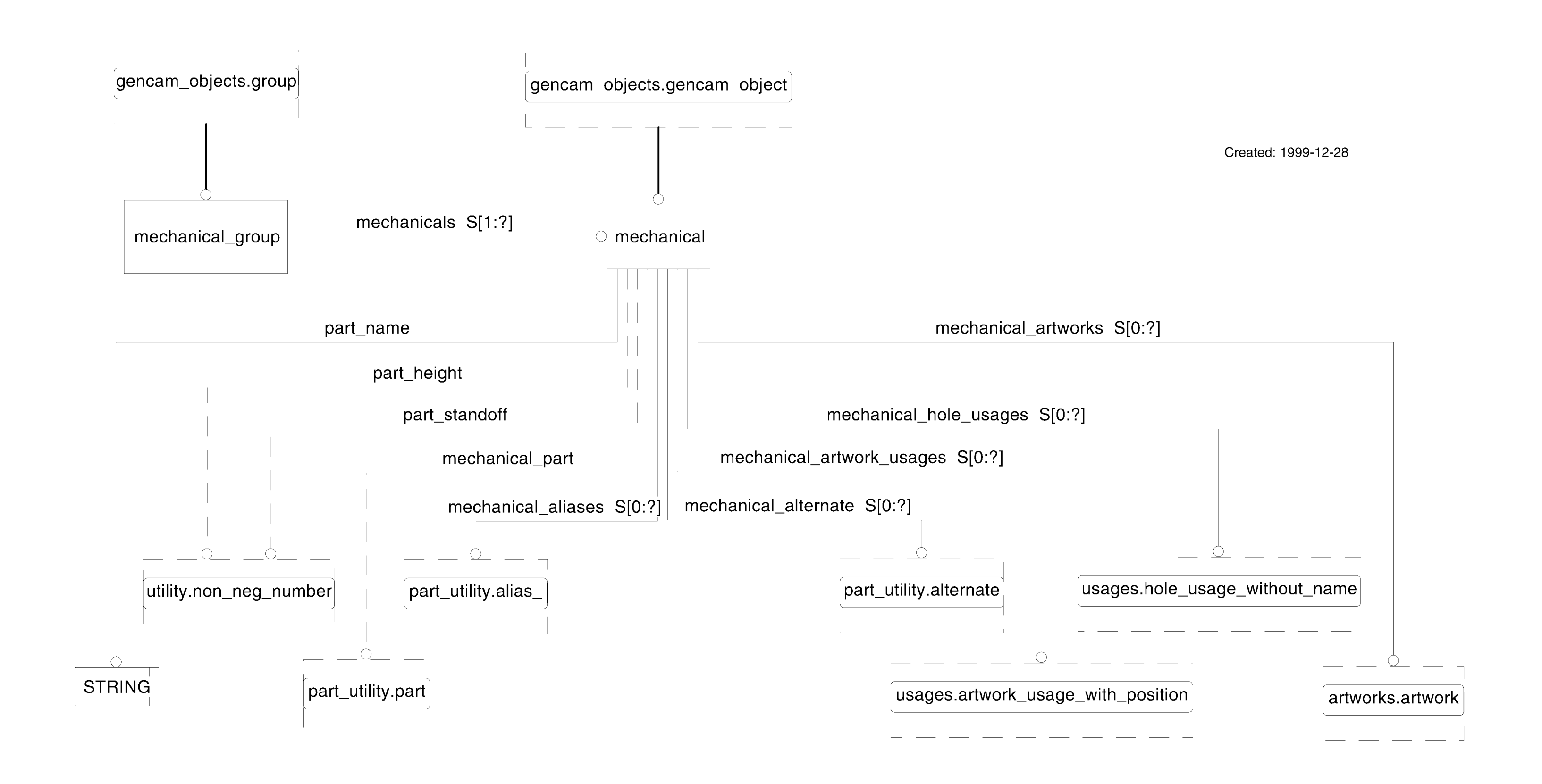


Figure 5-6 EXPRESS-G for MECHANICALS

6 REPORT GENERATORS

Data can be extracted from GenCAM files to produce various formats that are commonly used in the electronics industry. The types of reformatting can be used for electronic data transfer to tools or to facilitate inspection and human interpretation of text and/or graphic rendering. Note that no extraction tools are included in the IPC-2510 standard. Their creation is left to the industry as the need arises.

Figure 6-1 shows an example of a placement report generated from GenCAM format.

Ref No	Ref Des	Part No	Description	Component Placement X	Y	Side	Rotation	Shape
1	D1	1N6378	Diode	X01625	Y01000	TOP	0	DO41
2	D2	1N6378	Diode	X01625	Y01500	TOP	0	D041
3	D3	5082-2835	Diode, Schottky	X03375	Y01250	TOP	90	DO36
4	J1	550-3007	Connector	X01000	Y00100	TOP	270	
5	E1	74HCT126E	IC	X00500	Y00750	TOP	180	DIP24
6	E2	74HCT125E	IC	X01250	Y00750	TOP	180	DIP24
7	C1	C332C104M5U5CA	Cap, .1uF, 50v	X03500	Y00500	TOP	0	AXIAL
8	C2	C332C104M5U5CA	Cap, .1uF, 50v	X03500	Y01000	TOP	0	AXIAL
9	E3	MAX238CWG	IC	X02500	Y01000	BOTTOM	0	SOIC16
10	C4	C1206C104K5RAC	Cap, .1uF, 50v	X01750	Y01000	BOTTOM	180	1206
11	C5	C1206C104K5RAC	Cap, .1uF, 50v	X01750	Y01500	BOTTOM	180	1206
12		LAT-1-652-10	Label					
13		LAT-1-622-08	Label					
14		5101342	Board					
15	FID1		Fiducial, board	X00250	Y00250	BOTTOM		PAD, 0.040"
16	FID2		Fiducial, board	X00250	Y01750	BOTTOM		PAD, 0.040"
17	FID3		Fiducial, board	X03750	Y00250	BOTTOM		PAD, 0.040"
18	FID4		Fiducial, board	X03750	Y01750	BOTTOM		PAD, 0.040"

Figure 6-1 GenCAM for Board Assembly

7 REFERENCE INFORMATION

The following sections define reference documents that are useful in clarifying the products or process of the industry or provide additional insight into the subject of data modeling or released information models.

7.1 IPC (1)

IPC-2221	Design Standard for Rigid Printed Boards and Rigid Printed Board Assemblies
IPC-D-300	Printed Board Dimensions and Tolerances
IPC-D-310	Guidelines for Artwork Generation and Measurement Techniques for Printed Circuits
IPC-D-325	Documentation Requirements for Printed Boards, Assemblies and Support Drawings

7.2 American National Standards Institute (2)

ANSI X3/TR-1-77	American National Dictionary for Information Processing
ANSI X3.12	Subroutine Record Format Standardization
ANSI Y14.5	Dimensioning and Tolerancing for Engineering Drawing
ANSI Y32.1	Logic Diagram Standards
ANSI Y32.16	Electrical and Electrical Reference Designators
ANSI Z210.1	Metric Practice Guide (ASTM 380-72)

7.3 Department of Defense (3)

DoD-STD-100	Engineering Drawings

7.4 Electronic Industries Association (4)

EDIF 4 0 0	Electronic Data Interchange Format

7.5 International Organization for Standards (ISO)

ISO STEP Documentation

AP210	Electronic Printed Circuit Assembly: Drawings and Manufacturing
AP211	Electronic PC Assembly, Test Diagnostics & Remanufacture
AP221	Process Plant Functional Data & Schematic Representation

Appendix A

EXPRESS defines data objects and their relationships among data objects for a domain of interests. Some typical applications of data models include supporting the development of databases and enabling the exchange of data for a particular area of interest. As an example, a specific requirement of a database for an audio compact disc (CD) collection is shown in Figure 1.

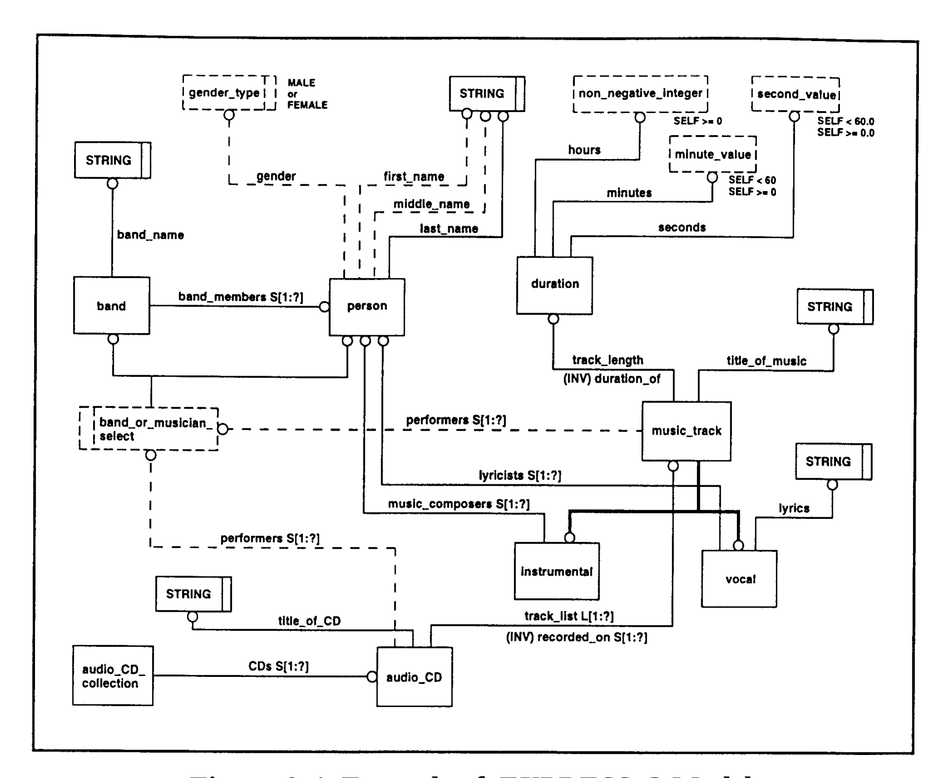


Figure A-1 Example of EXPRESS-G Model

Data models are specified in a data modeling language. EXPRESS is a data modeling language defined in ISO 10303-11. One of the advantages of using EXPRESS-G over EXPRESS is that the structure of a data model can be more intuitively presented. A disadvantage of EXPRESS-G is that complex constraints cannot be formally specified. There are specific symbols used in EXPRESS-G notation. The meaning of those symbols is defined in the EXPRESS formatting.